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FURTHER STUDIES ON THE ELIMINATION OF THE GREEN BODIES FROM THE ENDODERM CELLS OF HYDRA VIRIDIS.

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In a recent paper I called attention to the fact that when green hydras are kept in a 0.5 per cent. solution of glycerine for several days they gradually lose their green color and become colorless.¹ The green bodies were observed to be thrown out of the enteric cavity through the mouth but it was not determined how they became separated from the endoderm cells in which they are contained. It was a matter of conjecture whether the endoderm cells became detached from the walls of the enteric cavity and carried the enclosed green bodies with them, subsequently disintegrating and liberating the green bodies in the enteric cavity, or whether the endoderm cells became ruptured and let their contents flow into the enteric cavity and then out through the mouth.

A microscopical study of the endoderm cells of both the normal green hydras and the green hydras that had been in a 0.5 per cent. solution of glycerine from one hour to about three weeks gave the following results :

In the normal hydras the endoderm cells are about as long as broad and each contains a large vacuole at its inner end. Nearly all of the green bodies are at the base of the cells. Figs. 1 and 2 show respectively in a cross and a longitudinal section the condition of the endoderm cells in green hydras that were starved for fourteen days in clear water. Several which were starved only thirty-six hours were sectioned but the endoderm cells did not differ noticeably from those in the green hydras that were starved for two weeks. The animals were allowed to remain without food in order that the endoderm cells, free from food, might be compared with those of animals that had been in the glycerine solutions for the same length of time without food.

¹ BIOLOGICAL BULLETIN, 1907, XIV.

When green hydras are put into the glycerine solution the endoderm cells become larger. As the cells are closely packed together their expansion laterally is prevented. Consequently becoming larger they push out into the enteric cavity, becoming several times as long as in the normal animals. Fig. 3 shows the condition of the endoderm cells of a green hydra that had been in the glycerine solution for one hour. Some of the cells are about twice the length of those in normal hydras but otherwise they seem to be similar.

In Fig. 4 the endoderm cells are much longer and more narrow than in the preceding case. This hydra had been in glycerine solution for three hours. In Fig. 5 the endoderm cells are about the same size as in Fig. 4 but the interior of the cells is filled with a very fine granular substance and the green bodies are scattered about in this substance especially in the distal two thirds of the cells. Very few green bodies were seen near the free end of the cells. This section was from a hydra that had been in the glycerine solution for sixty hours.

The condition of the endoderm cells of hydras that were rendered entirely colorless by being kept in the glycerine solution for eighteen days or more, Fig. 6, differs only from the endoderm cells of hydras that had been in the glycerine solution for sixty hours in having no green bodies in the cells.

Each endoderm cell doubles its size at least within an hour after being put into the glycerine solution as is seen in Fig. 3. As it remains longer in the solution it becomes extended until it is ruptured and owing to the pressure of the adjacent cells extrudes much of its contents into the enteric cavity. As soon as there is an equilibrium of pressure the rupture quickly heals or regenerates thus making the cell intact again. Soon after it is whole it swells again until it is ruptured a second time and discharges more of its contents, including the green bodies, into the enteric cavity. This process is repeated as long as the animal is kept in the glycerine solution and if kept too long until its death. By this repeated process of the rupturing of each endoderm cell and the discharge of its contents all the green bodies of each cell are finally eliminated and the cells remain colorless.

The green bodies have been seen being ejected through the

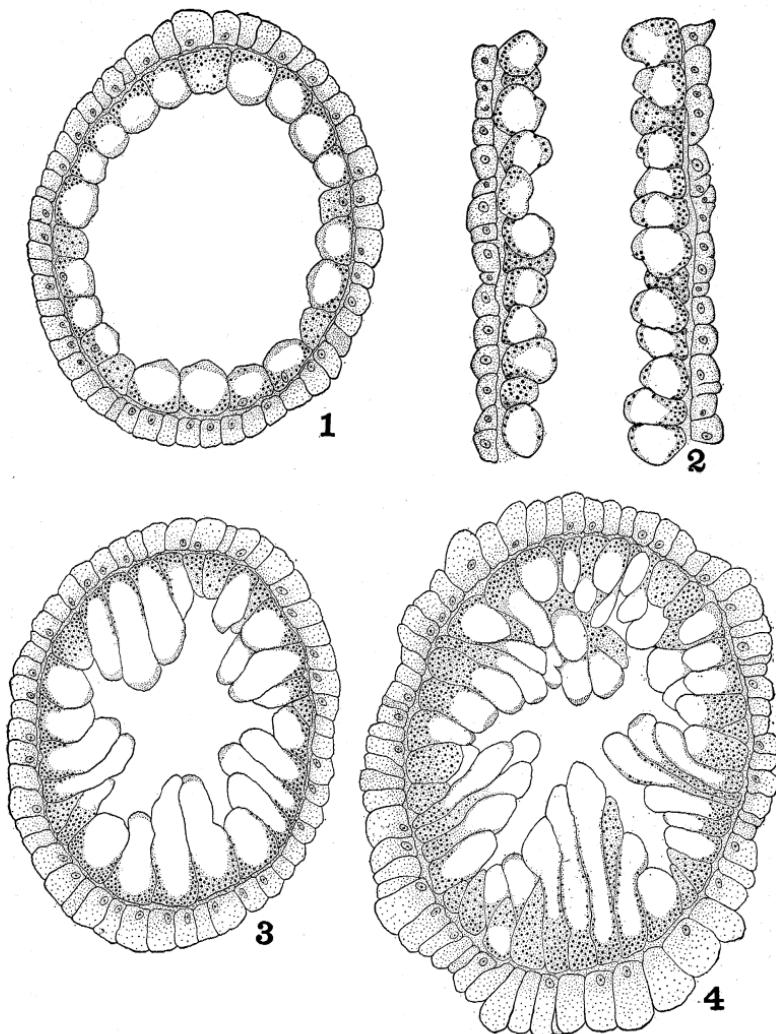


FIG. 1. Cross section of a green hydra that had been without food for 13 days.

FIG. 2. Longitudinal section of a green hydra that had been without food for 13 days.

FIG. 3. Cross section of a green hydra that had been without food for 36 hours and then put into a 0.5 per cent. glycerine solution for 1 hour.

FIG. 4. Cross section of a green hydra that had been without food for 36 hours and then put into a 0.5 per cent. glycerine solution for 3 hours.

mouth of living hydras which were in glycerine solution. They were also found in greater or less numbers in the enteric cavity

of the hydras that were sectioned and studied. They always seem to be free in the enteric cavity but sometimes they are mixed with a substance which resembles the granular contents of the endoderm cells. No free endoderm cells were ever seen in the enteric cavity.

Professor W. J. Gies was kind enough to perform some experiments for me in which blood corpuscles were put into a 0.5 per cent. solution of glycerine made with physiological salt solution. Upon measuring the diameters of the corpuscles both before and after putting them into the glycerine solution it was determined that if there was any change it was a slight shrinkage but never any enlargement of the corpuscles.

When these results of the effect of glycerine on blood corpuscles are compared with those obtained on the endoderm cells of hydras which were also kept in the same percentage of glycerine solution it is seen that the results are opposite—the corpuscles shrink and the endoderm cells become larger.

The shrinking of the corpuscles is probably due to an increase of the osmotic pressure of the solution caused by the addition of the glycerine and is purely a physical change.

The enlargement of the endoderm cells of hydras might be explained as due to the glycerine acting as a stimulus to the cell and causing certain vital processes in it to become active which result in a large and rapid absorption of water by each cell. The cells react to this stimulus as long as the animals are kept in the glycerine solution. Thus this change could be called a physiological one brought about by the stimulation of living processes in the cells.

Some cells were seen which had little protuberances or out-pocketings on their inner free ends which looked as though they might be weak places in the cell wall that were forced out by the increasing pressure from within. Doubtless the ruptures occur at these places.

As it is a well-known fact that hydras have extraordinary powers of regeneration in the closing of wounds, as when their bodies are cut into two or more parts, and also in the replacing of lost parts, the assumption that the ruptured places in the endoderm cells close and grow together quickly is not, I think, an improbable assumption.

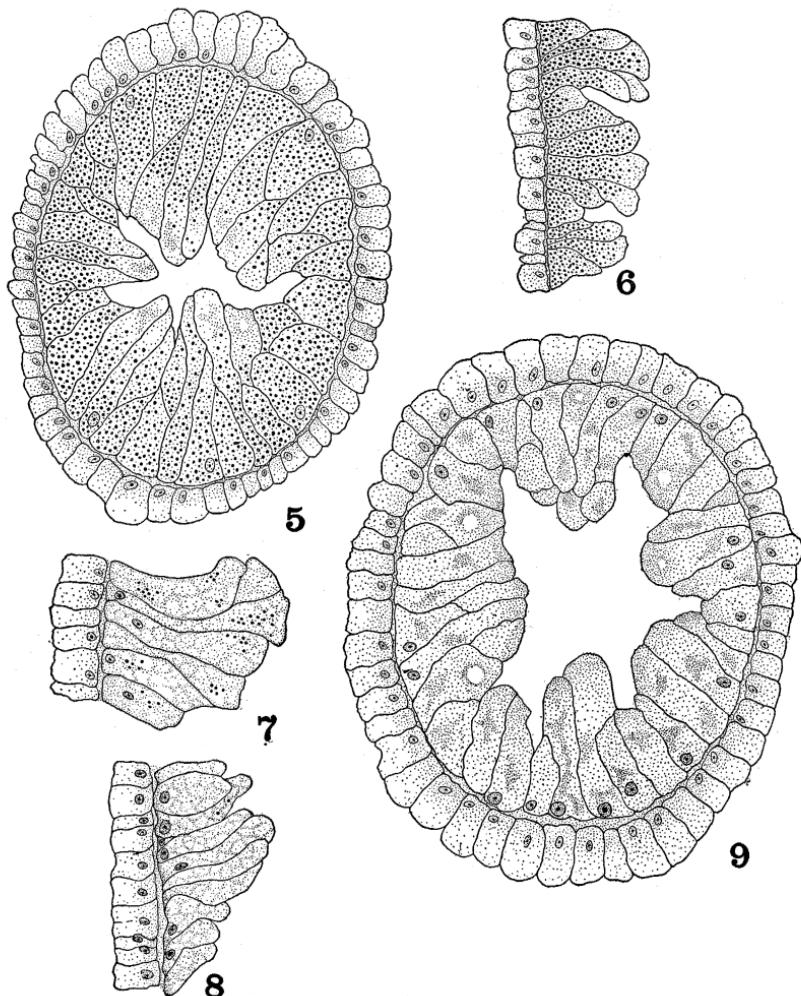


FIG. 5. Cross section of a green hydra that had been in a 0.5 per cent. glycerine solution for 60 hours.

FIG. 6. Portion of a longitudinal section of a green hydra that had been in the glycerine solution for 60 hours.

FIG. 7. Portion of a longitudinal section of a hydra that remained slightly green after being in a 0.5 per cent. glycerine solution for 13 days. Several groups of green bodies are seen in the endoderm cells.

FIG. 8. Portion of a longitudinal section of a hydra that was green when put into a 0.5 per cent. glycerine solution in which it remained 13 days and was rendered colorless. Only two green bodies seen in this section.

FIG. 9. Cross section of a hydra that was green when put into a 0.5 per cent. glycerine solution in which it remained 18 days and was rendered colorless. No green bodies are seen in this section.

Whatever the exact process may be it is certain that the endoderm cells remain in a greatly distended condition and lose all of their green bodies, many of which are found free in the enteric cavity.

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NEW YORK CITY, May 29, 1908.